Space Weather Technical Forecast

Issued on Thursday, 26 October 2023 at 13:25 Local

This technical forecast provides a four day assessment of space weather events. The probabilities stated below are for reaching or exceeding the given levels. For more information about space weather impacts please see the Met Office Space Weather Scales https://www.metoffice.gov.uk/weather/learn-about/space-weather/uk-scales

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Space Weather Forecast Headline: Chance G1/Minor Storm intervals day 1 and day 4

Analysis of Space Weather Activity over past 24 hours

Solar Activity: Low with peak flare C3.0 at 25/2244 UTC from a new sunspot region in the northeast disc. This is one of four regions on the Earth-facing disc, two of which are numbered, however these are all relatively small and simple. The other three regions, including AR3468 and AR3471 are in the southwest disc. Further small 'pore' like proto-spots also situated within the plage on the northeast disc. These bring the potential for further sunspot development through the coming days.

No Earth-directed CMEs have been observed.

Solar Wind / Geomagnetic Activity: The solar wind, as measured by DSCOVR and ACE at L1, showed a likely connection to CH64. Solar wind speeds steadily increased from background, near 300km/s, to be slightly elevated around 410 km/s. Density was mostly average to below average Interplanetary Magnetic Field (IMF), Bt, was initially weak, below 5nT, but increased in a step-wise fashion to be Moderate at 10-14nT. The north-south component, Bz, was predominately negative (southward), with a similar increasing trend in magnitude. By the end of the period, this was ranging between +7 and -12nT. Phi angle as initially variable but increasingly of a positive (away from the Sun) orientation. Geomagnetic activity was Quiet to Unsettled (Kp 0-3) with one Active interval (Kp4) 26/0900-1200 UTC.

Energetic Particles / Solar Radiation: GOES16 high energy (greater than 10MeV) proton flux was at background levels. GOES16 high energy (greater than 2MeV) electron flux was mainly background, briefly reaching Moderate with peak 292 pfu at 25/1830 UTC. Associated 24-hour fluence was well below the Active (1e8 integrated pfu) threshold. The observation at 26/0000UTC was 7.24e6 integrated pfu.

Four-Day Space Weather Forecast Summary

Solar Activity: Low activity forecast with occasional C-Class flares. There is a slight chance of M-flares, perhaps increasing slightly through the period depending upon any further sunspot development.

Solar Wind / Geomagnetic Activity: There are no Earth directed CMEs. Current fast wind onset has been attributed to CH64, although there is some uncertainty due to a mismatch in the polarity of the high speed stream. Weak fast winds are expected to continue on day 1-2 (26-27 Oct), likely peaking around 450 km/s, before easing to background. The next enhancement from CH65/66 is then expected either late day 4 or just beyond this forecast period (29-30 Oct). Quiet to Unsettled geomagnetic activity is expected day 1 and early day 2 (26-27 Oct) with a chance of Active to G1 Minor Storm intervals. Easing to mainly Quiet with isolated Unsettled spells later day 2 onward. G1/Minor storms are likely with the onset of CH65/66 fast winds, however due to the uncertainty with timing, this brings only a chance of these conditions by the end of day 4 (29 Oct).

Energetic Particles / Solar Radiation: High energy (greater than 10MeV) proton flux is expected to persist at Background. High energy electron flux (greater than 2MeV) is expected

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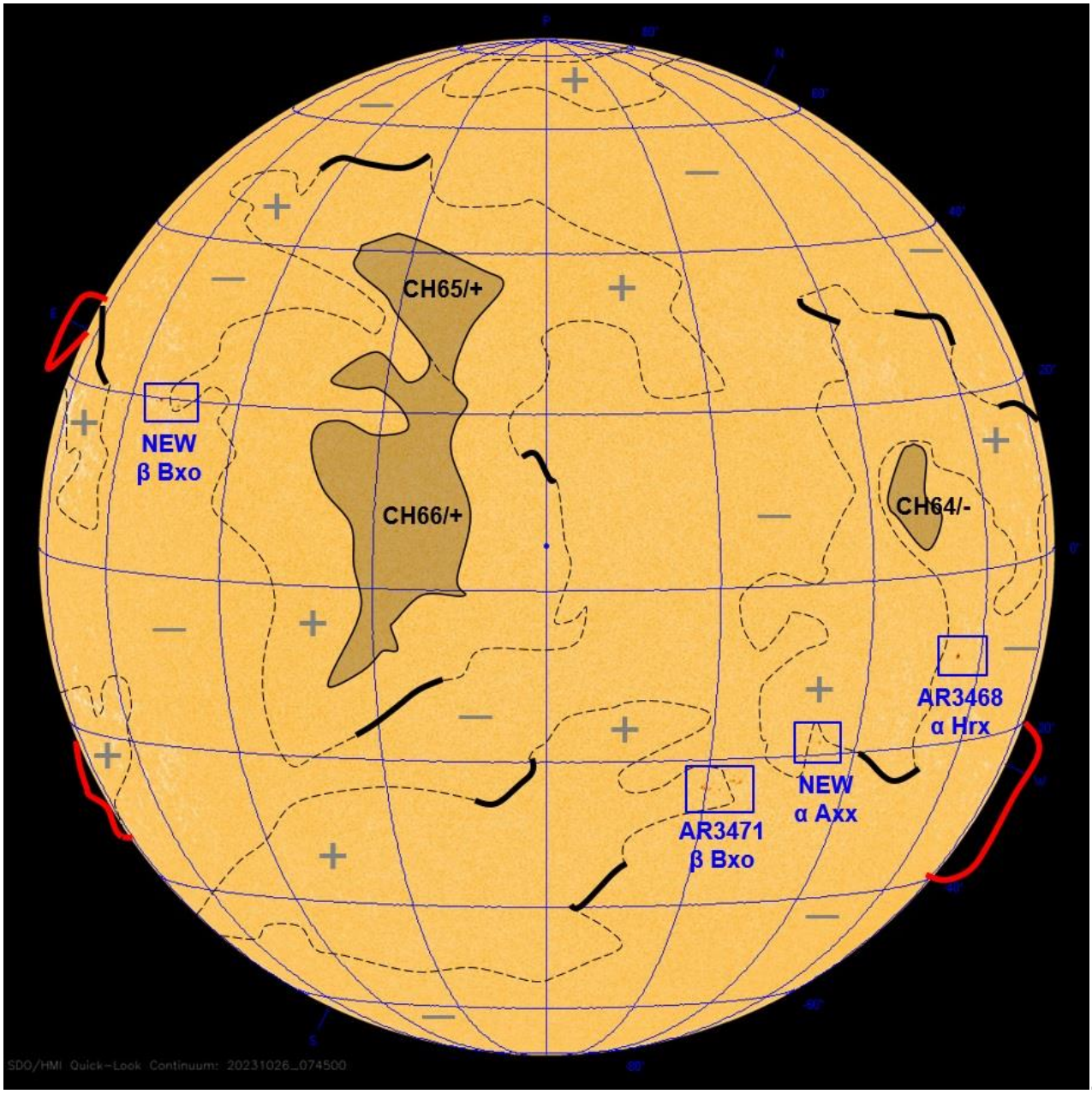
see a small increase from background to moderate at first, with a chance of reaching High at diurnal peak by day 3 (28 Oct). The associated 24 hour fluence is forecast to remain below the Active threshold (1e8 integrated pfu).

Figure 1. Solar Analysis Valid 26/0800 UTC.



Key: Filament ___ , Prominence ___ , Magnetic Field Line - - - , Polarity +/-, Coronal Holes: Grey shaded area CHxx +/-, Sunspot groups 25xx - Mt Wilson α-β-βγ-βγδ and Zurich-McIntosh Axx etc.

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Geomagnetic Storms:

There are no Earth-directed CMEs.

A weak enhancement is ongoing, likely due to a connection CH64. There is some uncertainty however as the current phi angle suggests a weak connection to a positive hole. However, this feature was assessed negative in recent analysis, but as positive while in the centre disc. This is perhaps suggestive of either a more mixed polarity environment or in favour of the original positive analysis, or an alternative source. For now, this enhancement is assumed to be from CH64 with peak winds of around 450 km/s likely.

MOSWOC Enlil then suggests a strong fast wind onset on day 3 (28 Oct), however this is likely an overestimation of the fast winds of CH65/+ and CH66/+, which are new features on this rotation. These are expected either late on day 4 (29 Oct) or early day 5 (30 Oct).

Quiet to Unsettled geomagnetic activity is expected day 1 and early day 2 (26-27 Oct) with a chance of Active to G1 Minor storm intervals, due to the onset of fast winds from CH64. Easing to mainly Quiet with isolated Unsettled spells later day 2 onward. G1/Minor storms are likely with the onset of CH65/66 fast winds, however due to the uncertainty with timing, this brings only a chance of these conditions by the end of day 4 (29 Oct).

Geo-Magnetic Storm Probability (Exceedance)	Level	Past 24 Hours (Yes/No)	Day 1 (00-24 UTC) (%)	Day 2 (00-24 UTC) (%)	Day 3 (00-24 UTC) (%)	Day 4 (00-24 UTC) (%)
Minor or Moderate	G1 to G2	No	20	5	1	30
Strong	G3	No	1	1	1	1
Severe	G4	No	1	1	1	1
Extreme	G5	No	1	1	1	1

Figure 2a: SDO aia-211 of previous rotation (left) and current (right) – Markedly different CH structure.

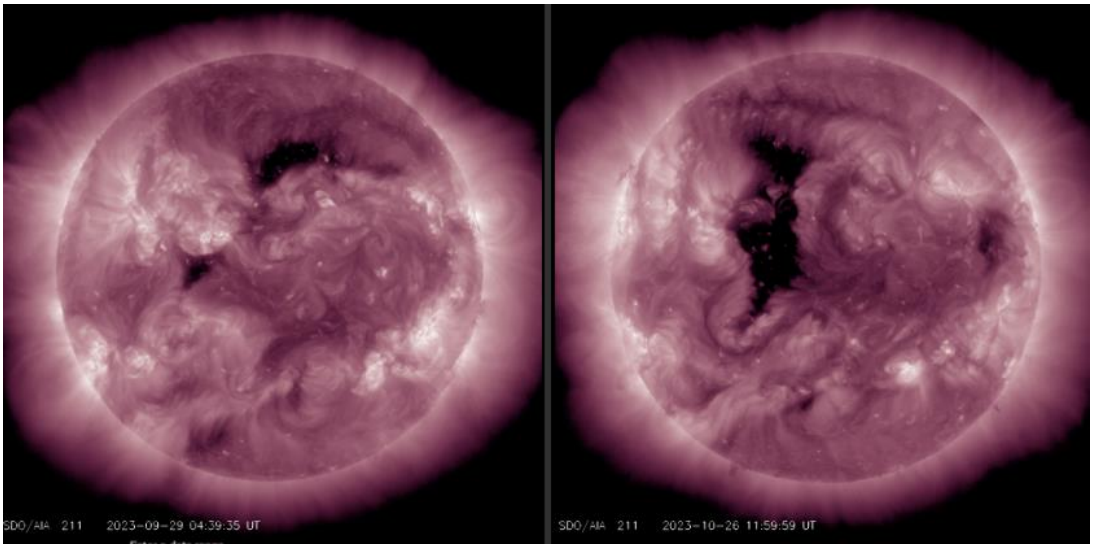

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Figure 2b: Enlil showing earlier than expected arrival of fast winds from CH65/66

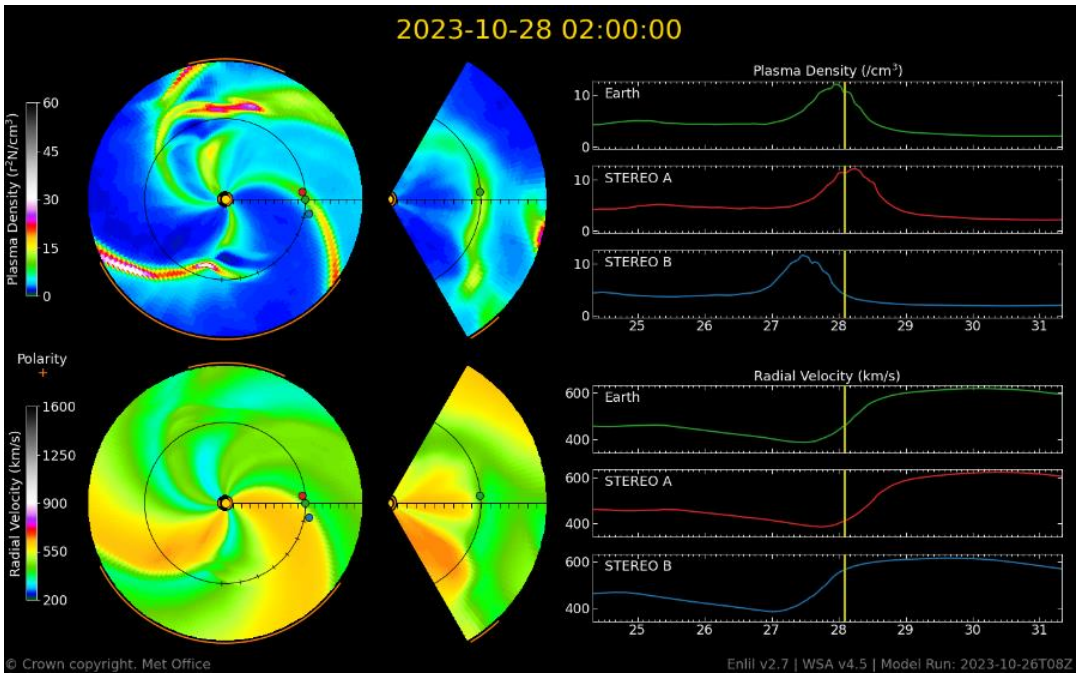
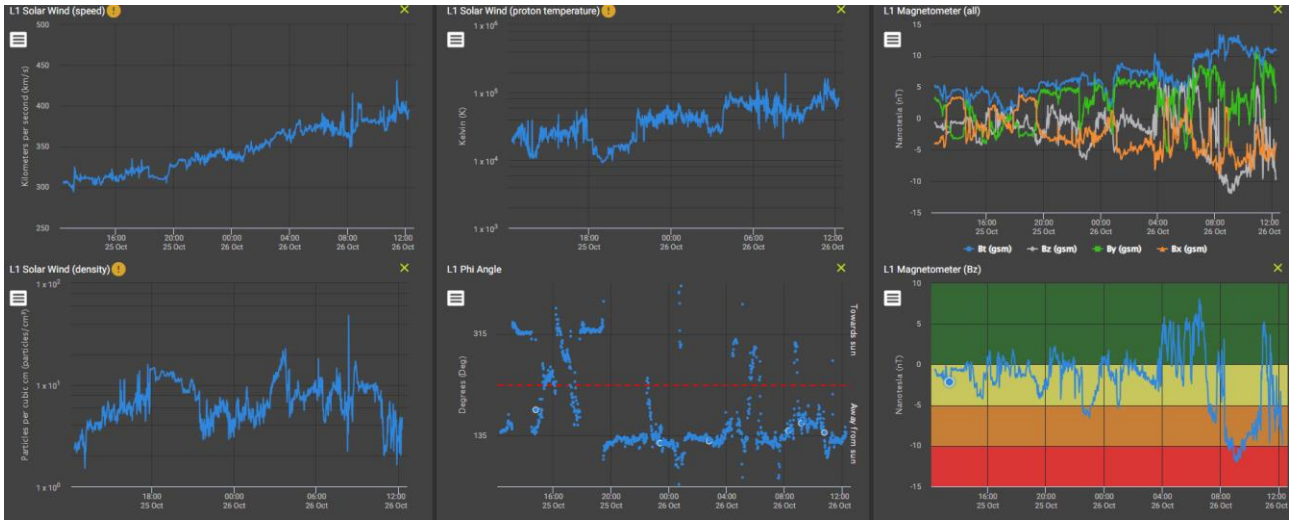


Figure 2c: Current solar winds, showing weak enhancement to CH64



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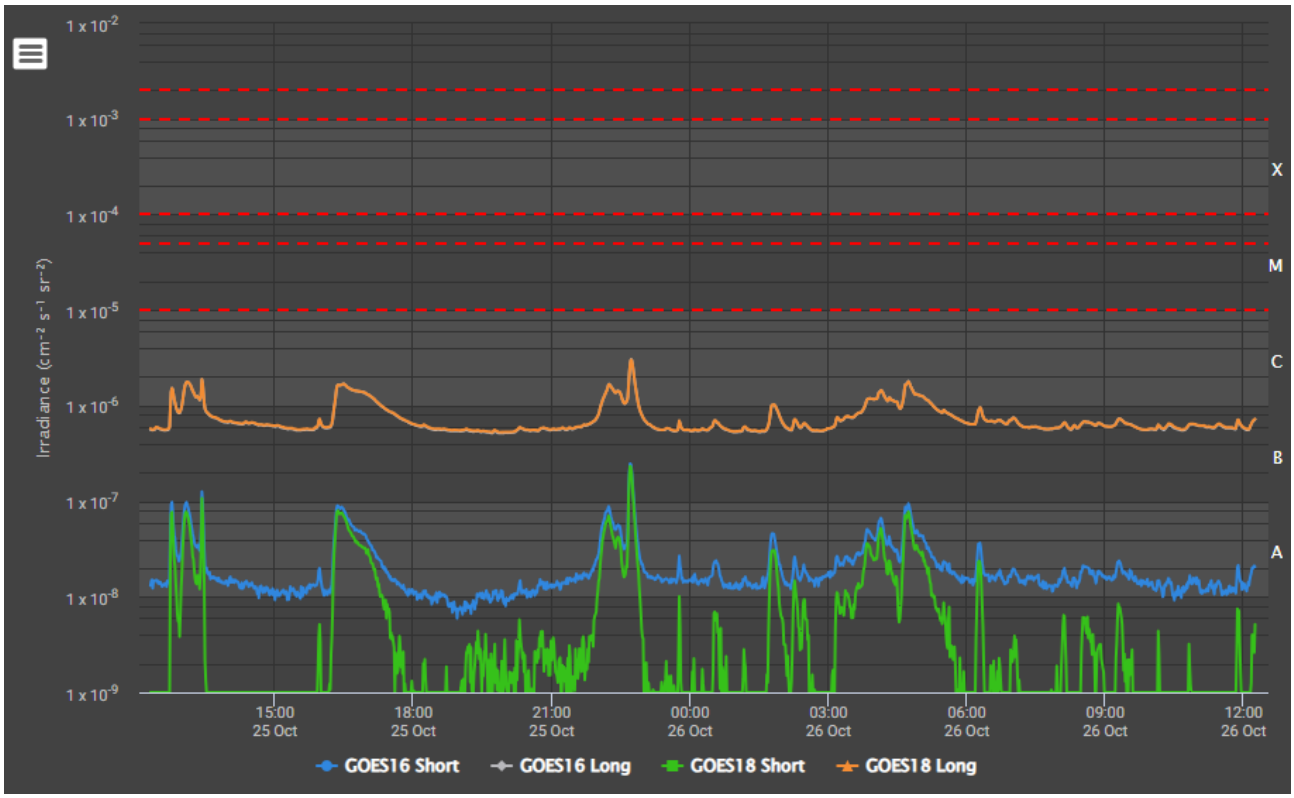
Radio Blackouts - X-Ray Flares:

Low activity is expected with only a slight chance of M-flares.

There are four sunspot regions on the disc. Two numbered in the southwest disc, which are both small and declining with minimal activity. There is a further small unnumbered unipolar spot on the southwest which was the source of the largest C-class flare in the last 24 hours. A small bipolar region has also developed on the northeast disc, with further small 'pore' like proto-spots also situated within the nearby plage. These bring the potential for further sunspot development through the coming days.

X Ray Flares	Level	Past 24 Hours (Yes/No)	Day 1 (00-24 UTC)	Day 2 (00-24 UTC)	Day 3 (00-24 UTC)	Day 4 (00-24 UTC)
Probability			(%)	(%)	(%)	(%)
Active	R1-R2 M Class	No	5	10	15	20
Very Active	R3 to R5 X Class	No	1	1	1	1

Figure 3: GOES-16/18 X-ray flux



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Solar Radiation Storms - (High Energy Protons):

The high energy (greater than 10MeV) proton flux observed by GOES16 is expected to persist at background levels in the absence of significant sunspot regions on the visible disc.

Radiation Storms Probability (Exceedance)	Level (cm^{-2} sr^{-1} s^{-1})	Past 24 Hours (Yes/No)	Day 1 (00-24 UTC) (%)	Day 2 (00-24 UTC) (%)	Day 3 (00-24 UTC) (%)	Day 4 (00-24 UTC) (%)
Active	**≥ S1**	No	1	1	1	1
Very Active	**≥ S3 ***	No	1	1	1	1
* S3 ≥ 10 MeV ≥ 1000 pfu and / or ≥ 50 MeV ≥ 10 pfu. (pfu = $cm^{-2}sr^{-1}s^{-1}$)						

High Energy Electrons Event (≥ 2MeV):

Electron flux observed by GOES16 at GEO is currently at Background levels with only slight diurnal rises to Moderate expected. Some increase to electron populations through the Van Allen Belt is possible through the period due to the weak coronal hole enhancement forecast on day 1 (27 Oct) from CH64, bringing a slight chance of reaching High at diurnal peak by day 3 (28 Oct). The following fast wind from CH65/+ and CH66/+ is anticipated to have a more significant impact on electron populations, however this is not expected until beyond the current forecast period (30 Oct onward).

The associated 24hr electron fluence is forecast to remain below the Active level. This is supported by REFM, while persistence provides a poor guide due to influence of CMEs on the previous rotation.

GEO Electron Environment Probability (Exceedance)	Level (cm^{-2} sr^{-1} day^{-1})	Past 24 Hours (Yes/No)	Day 1 (00-24 UTC) (%)	Day 2 (00-24 UTC) (%)	Day 3 (00-24 UTC) (%)	Day 4 (00-24 UTC) (%)
Active	**≥ 2 MeV ≥ $1x10^8$**	No	1	1	1	1
Very Active	**≥ 2 MeV ≥ $1x10^9$**	No	1	1	1	1

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